

Honda M4VA and SZCA CVT Pressure Controls

by Sean Boyle

While some manufacturers are questioning their faith in continuously variable transmissions (CVTs), others are kicking production into high gear (or something equivalent). Honda has always been a leader in CVT technology and reliability, but the production of Hondas equipped with CVTs is still fairly low. Without a doubt, CVTs are relatively rare transmissions. But with fuel costs rising, the newer, fuel-efficient hybrids have recently become more attractive to many consumers, and one thing that makes hybrids practical and fuel efficient is the CVT.

For now there are only two Honda CVTs in production:

- M4VA in the 1996-to-2000 Civic HX
- SZCA in the 2001-to-current HX, Insight, and Civic hybrids

The two models essentially operate the same way, but there are differences between them. Honda has refined the electronics, hydraulics, and even the mechanical configuration as the CVT evolved from the M4VA to the SZCA. Let's look at how each of these Honda CVTs achieves the pulley ratio changes and sheave (pulley) pressure.

Pressure Testing

For the most part, pressure testing a Honda vehicle is difficult. First, Honda doesn't use conventional pressure taps. The pressure tap is an 8 x 1.25 metric thread with an aluminum sealing washer.

Second, they put the pressure taps in the worst possible places. When attempting to check pressures, have



Figure 1: While Honda provides pressure taps for nearly every circuit in the unit, connecting your gauge to these taps often requires extensive plumbing.

plenty of fittings and adapters on hand to make life a little easier. I've resorted to making homemade fittings by drilling a small 1/8" hole through the center of a bolt and welding a 1/8" pipe fitting to it (figure 1).

On a positive note, Honda provides a pressure tap for most, if not all, of the circuits in the transmission. So pressure tests can provide excellent insight into hydraulic and electronic failures.

Be careful performing pressure tests on these units: The Honda CVT can reach more than 500 PSI, so never use a conventional 300 PSI gauge.

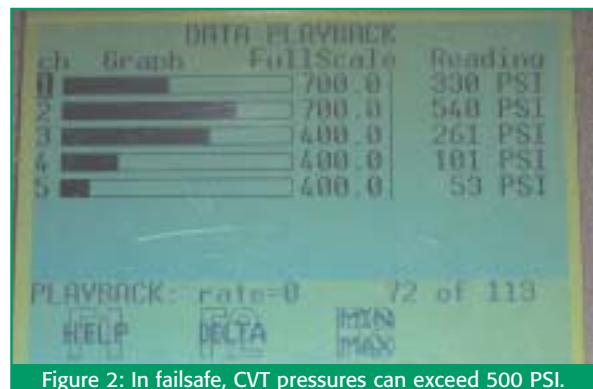


Figure 2: In failsafe, CVT pressures can exceed 500 PSI. Always use a pressure gauge with adequate range, or better yet, use a pressure transducer for hydraulic testing.

Consider an electronic pressure transducer, not only because of the ranges available, but for its recording capabilities. The pressure test shown is on a CVT in failsafe mode (figure 2). Keep in mind, the driven pulley pressure reaches 540 PSI. All this from a small, chain-driven, positive displacement pump.

NEW

INDUSTRY FIRST



SUV & TRUCK

Automatic Transmission
Fluid Treatment

**EXTREME
LOAD
FORMULA**

SMART BLEND

SYNTHETICS

Smart Blend Synthetics Truck and SUV treatment is specially engineered and formulated with advanced SYNTHEUM™ technology. It is recommended for use as an ATF treatment when replacing or topping off fluid for all Trucks, SUV's, 4X2 & 4X4 and racing applications with automatic transmissions.

- An ideal treatment for automatic transmissions under heavier loads such as hauling, towing and racing. (Diesel or gas, 4X2 or 4X4 trucks and SUVs with light, medium or heavy duty applications)
- Prevents overheating, foaming and oxidation
- Reduces wear on internal components
- Ensures and maintains proper shifts



Part #16000



**LIFE AUTOMOTIVE
PRODUCTS INC.®**

Cordova, TN 38018

OEM Approved Supplier

1-800-525-6816 or visit our website: smartblend.com

901-522-8244 • FAX: 901-525-6833 • Email: lifeauto@aol.com



Figure 3: Under normal operation, pressures are more reasonable, although Honda doesn't offer a complete set of pressure specs.



Figure 4: The Honda CVT blends the pressures from the PH/PL solenoid to adjust the width of the sheaves (pulleys) and control drive ratio.

If the CVT is operating correctly, the normal pressure range isn't that alarming (figure 3). In neutral at 1700 RPM, you should expect 50 – 92 PSI at the drive pulley, 92 – 140 PSI at the driven pulley. In drive, you should have 228 – 267 at the forward clutch. The lube circuit should produce 36 – 58 PSI in neutral, at 3000 RPM.

The service manual doesn't provide specifications for stall or moving pressure ranges, but look for the start

clutch, drive, and driven pulley pressures to increase with engine torque. The relationship between drive and driven pulley pressures will change as you drive the vehicle. This changes the effective ratio of the drive and driven pulleys (figure 4).

Pressure Control

Honda relies on two pulse width modulation (PWM) solenoids to control how much pressure each sheave

(pulley) receives. The design and responsibility of each PWM solenoid is different between the two generations of transmissions (figures 5A and 5B).

Early CVT (M4VA)

A PH/PL solenoid controls overall line pressure, which is also termed PH (Pressure, High). The PH/PL solenoid also controls PL (Pressure, Low), which works with PH pressure to establish ratios and sheave pressure. Think

INTRODUCING

Platinum Torque®

NATIONAL DRIVETRAIN INC

QUALITY REBUILT

Manual Transmissions & Transfer Cases

HUGE INVENTORY- VOLUME DISCOUNTS

Also: Complete Rebuild Kits with OE quality parts

Call and request a credit application today

TOLL FREE ORDER LINE

1-800-507-4327

You can order online and use our complete buyers guide at: www.nationaldrivetrain.com

Take Note:

We beat anyone's published price on Ring and Pinions

Standard 12 Month Unlimited Mile Warranty. Extended Warranties available



Figures 5a and 5b: A look at the physical differences between the early (left) and late (right) CVT valve bodies.

of the PH/PL solenoid circuit as controlling the *amount* of pressure in the CVT.

The Shift Control Solenoid is responsible for distributing the PH and PL pressure between the drive and driven pulleys. The shift control solenoid acts on the shift control valve to deliver a combination of PH and PL pressure to a given pulley. The TCM then monitors the speed ratio through one of its four speed sensors and adjusts accordingly.

Think of the shift control solenoid as controlling the pressure *ratio* between the drive and driven pulleys.

Late CVT (SZCA)

The late model CVT valve body looks similar to the earlier unit, but the hydraulic functions have changed dramatically. A separate Drive Pressure Control solenoid and Driven Pressure Control solenoid replace the PH/PL solenoid and the shift control solenoid

in the M4VA units, and satisfy all of the pressure and ratio functions. Each solenoid will determine the amount of pressure for its respective pulley, in addition to influencing line pressure.

Here's how it works:

Honda's PWM solenoids mechanically assist the valves they control. When energized, the solenoid plunger extends, forcing the valve against spring pressure. Take a look at the

YOUR CONNECTION FOR THOSE IMPOSSIBLE-TO-FIND CONNECTORS

REPAIR CONNECTORS If we don't have it, NO ONE DOES!

You don't have to buy the whole harness!

42RE
A4LD
4E60E

SPEED SENSOR CONNECTORS

Ford
4L60E
4L80E

MLPS/LPS CONNECTORS

Ford Trucks
Ford Cars
4L60E

Way BELOW Dealer Prices! Call Now!

Schaeffer has the largest inventory of repair adapters and repair kits available in stock for immediate delivery.

Huge selection of sensors for Ford and GM including the 4L60E & 4L80E

Ask us about our special pricing during the months of SEPTEMBER on overstock merchandise!

SCHAFFER
Test Products, Inc.

CALL 877-SHIFTER
Technical Support: (863) 859-1070
Internet: www.schaeffertest.com

1425 STAGECOACH RD
SHAKOPEE, MN 55379
VOICE 800-800-9274
FAX 952-445-0231
www.powerpusher.com

The changes in pressure between the PH and PL are linear: As the TCM reduces the duty cycle signal to the PH/PL solenoids, both PH and PL pressure increase.

hydraulic schematic: each PWM solenoid works along with regulated pressure to move its valve to the right, which cuts off its own fluid supply.

When the PWM duty cycle is high, the mechanical assist from the PWM solenoid is high, requiring less hydraulic pressure to move the valve to the right (figure 6). This creates lower solenoid signal pressure. If power were interrupted at the solenoids, the valves would have no mechanical assist from the solenoids, so they'd require more hydraulic pressure to move the valves to the right. This would boost solenoid signal pressure.

In earlier CVTs, the PH/PL solenoid (6) regulated pressure to the PH control valve (7) and the PL control valve (5). The PH control valve, as its name implies, controls PH pressure, which is basically line pressure (figure 7). The PL control valve lowers PH pressure, which helps control the ratio between the pulleys.

1	Driven Pulley
2	Drive Pulley
3	Shift Control Solenoid
4	Shift Control Valve
5	PL Regulator Valve
6	PH/PL Solenoid
7	PH Control Valve
8	PH Regulator Valve

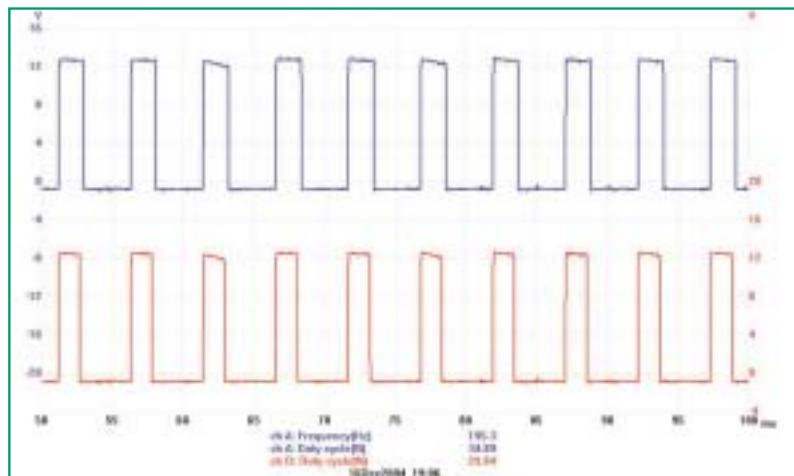


Figure 6: The TCM controls the PH/PL solenoids with a variable duty cycled signal. As signal on-time increases, pressure decreases.

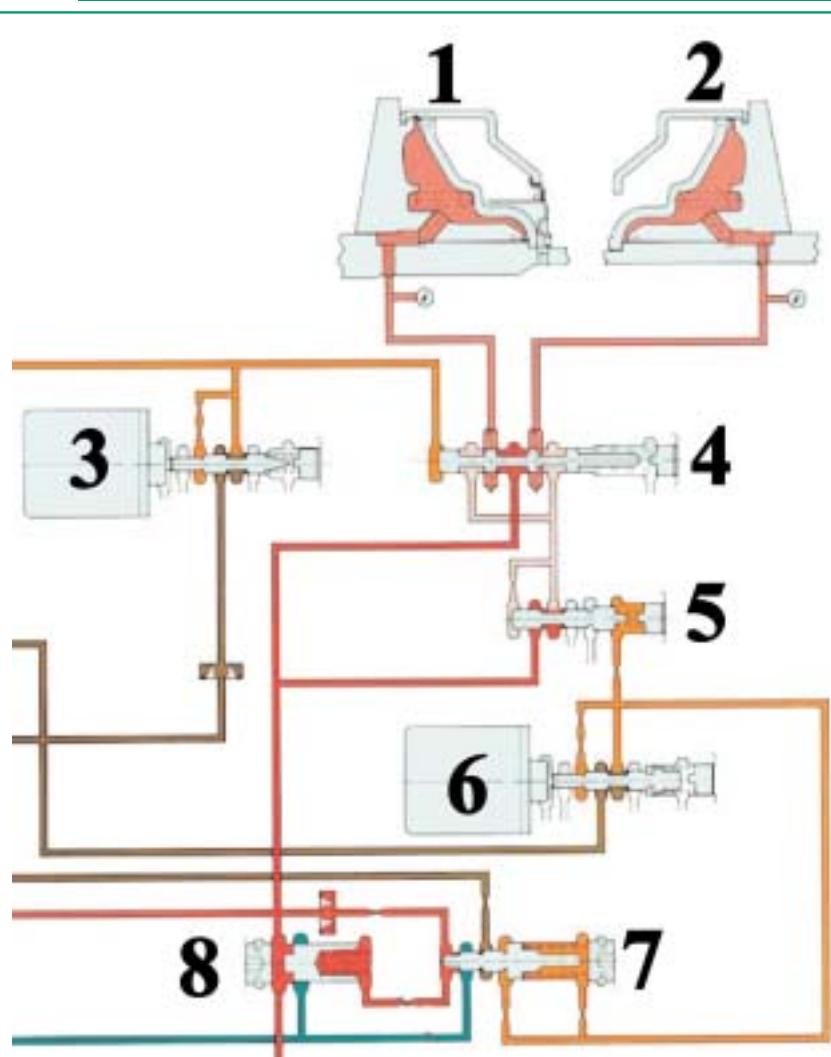


Figure 7: On early Honda CVTs, the PH/PL solenoid (6) controls pressure for both pulleys; the shift control solenoid (3) controls regulates how much pressure applies to each pulley.

WE HAVE A TRANSMISSION SOLUTION FOR ANY VEHICLE.



(WELL, ALMOST ANY)

As THE TECHNOLOGICAL LEADER,
PRECISION INTERNATIONAL'S REPAIR KITS ARE TRULY STATE OF THE ART.

Name any year, make or model. Give us any transmission problem. Chances are we've got a solution. Not just any solution, but one that will really work and keep on working – backed by solid engineering, the latest specs and our reputation for giving you and your customers reliable performance and the utmost peace of mind. When you see the Precision International name on one of our transmission repair kits, you can feel confident you've got the very best. All are cross-checked against OEM specs. All changes are noted and made. And we always use OE parts or better. Spaceships? We haven't helped repair one of those yet. But who knows what tomorrow will bring!



CAUSE: The front pump seal may have been installed too deeply into the converter housing. This can cause the seal to block off half of the drain back hole in the pump, leading to an increase in oil pressure behind the seal. Which, in turn, can make the front seal pop out of the housing or oil to blow past the seal between its lip and converter hub.

SOLUTION: Precision International's redesigned Vamac® front pump seal number K63704. It's pre-notched and indexed to avoid blocking the drain back hole. You can order the seal, including complete installation instructions, under the number Sub-K63704.

© Viton is a Registered Trademark of DuPont.



THE LATEST SOLUTION FROM THE PROBLEM SOLVERS

RL4F02A/V – RE4F02A/V

PROBLEM: Before and/or after rebuilding a transmission, the vehicle has repeated front seal leaks. The front seal may appear to have popped out of the converter housing.



**PRECISION™
INTERNATIONAL**

The Problem Solvers.

210 Knickerbocker Ave., Bohemia, NY 11716
(631) 567-2000 • Fax (631) 567-2640 • Toll Free: 800-872-6649
Florida Office:
455 Lakeview Drive, Coral Springs, FL 33071
(954) 509-8950 • Fax (954) 509-8945
E-mail: sales@transmissionkits.com
www.transmissionkits.com

The changes in pressure between the PH and PL are linear: As the TCM reduces the duty cycle signal to the PH/PL solenoids, both PH and PL pressure increase. The overall pressure changes in the PH and PL circuits, but the shift control solenoid (3) still controls how those pressures apply to each pulley.

The shift control solenoid receives modulator (solenoid) pressure and alters it into shift control solenoid signal pressure. This pressure acts on the shift control solenoid valve, which is responsible for delivering the PH and PL pressures to the pulleys for ratio control.

When the PWM signal is high, shift control solenoid signal pressure is low, moving the shift control valve (4) toward the left. This delivers more PH pressure to the driven pulley (1) and more PL pressure to the drive pulley (2). This pressure arrangement moves the pulleys into a low ratio, such as you might expect during acceleration.

As vehicle speed increases, the shift control valve moves toward the right. This reverses the blend, sending more PH pressure to the drive pulley, and more PL pressure to the driven pulley. This configuration creates a higher ratio, similar to overdrive on a conventional transmission.

The mechanical operations of the late-model CVT solenoids are the same as the earlier unit, but the hydraulic functions are different. Look at the late model CVT hydraulic schematic (figure 8): the drive (6) and driven (5) pressure control solenoid signal pressure affects drive and driven pressures as well as overall line pressure.

All of the valves in the CVT except the reverse inhibit valve are balance-type valves, that regulate circuit pressure by balancing hydraulic pressure, spring force, and, in the case of the solenoid-operated valves,

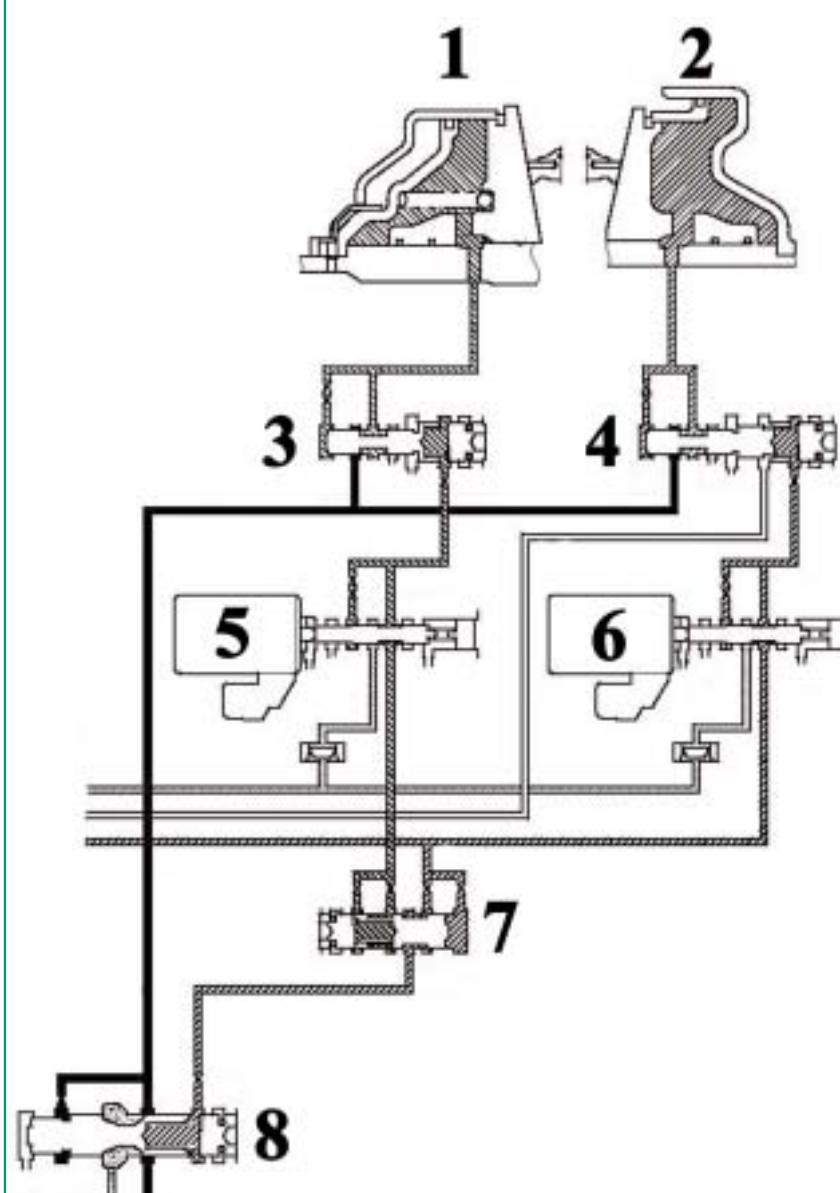


Figure 8: On later Honda CVTs, the drive and driven pulleys each have their own PH/PL solenoid, which also control overall line pressure.

1	Driven Pulley	5	Driven Press Control
2	Drive Pulley	6	Drive Press Control
3	Driven Pulley Control	7	PH Control Valve
4	Drive Pulley Control	8	PH Regulator Valve



**G O
S I G N I F I C A N T L Y
B E Y O N D
T H E C O M P E T I T I O N.**

Go Beyond.

Tradition



Engineering



Innovation



Vision



Leadership



Passion



Performance



Ambition



Dedication



Know How

The BorgWarner
Indianapolis 500 Trophy
is a registered trademark
of BorgWarner Inc.



Since 1928, the BorgWarner name has been synonymous with pioneering innovation in the world-wide automotive industry. Our leadership in product development has resulted in an impressive list of "firsts" – from the first mass produced automatic transmission to our recent innovation of Torque on Demand (TOD)[™] systems for all-wheel drive. Today, BorgWarner advances its long tradition of ambition and vision with new technology dedicated to high energy applications and full systems product strategies for our OEM customers.

BorgWarner has available for your transmission shop virtually every automatic transmission part we manufacture for the world's leading vehicle makers. That's more than 450 no-risk OEM quality components for over eighty transmissions world-wide, including our new line of high performance friction products for race-ready transmissions.

Go significantly beyond the competition. Make BorgWarner your one-stop source for automatic transmission parts that are competitively priced, readily available and guaranteed to fit your rebuilds. Call your authorized distributor today and ask for the original parts from the leader in automatic transmission technology...BorgWarner Inc.

 **BorgWarner**

BorgWarner Inc. Transmission Systems
1350 North Greenbriar Drive Unit B Addison, IL 60101 (630) 261-9980

www.bwauto.com

*BorgWarner
makes OEM
quality parts for
over 80 transmissions
world-wide, including
FLEX-BAND[™],
UNI-BAND[™] and
MAJI-BAND[™]
transmission bands,
friction plates and
one-way clutches.*



Contamination is an important issue with CVT units: Whatever you're doing in a CVT, keep it clean.

mechanical solenoid force. The late model CVTs have greater control over how much pressure each pulley receives, because they use separate solenoids and hydraulic circuits for the drive and driven pulleys.

Both generations of CVT use low-resistance PWM solenoids, measuring between 3.8 and 6.8 ohms. At room temperature you should measure around 5 ohms. The reverse inhibit solenoid is the only on/off solenoid in the CVT, with between 11.7 and 21 ohms. The reverse inhibit solenoid works like other Honda on/off solenoids, hydraulically trapping pressure when it's de-energized.

Service Notes

You can reach all of the solenoids through the bottom pan, but be careful with the electrical connectors: The shift control solenoid and the start clutch solenoid use the same connectors on early M4VA units. The drive pulley pressure control solenoid and the start clutch solenoid have the same connector on SZCA units. These solenoid connectors reach each other easily, and won't look out of place if you cross them (figure 9).

Contamination is an important issue with CVT units: Whatever you're doing in a CVT, keep it clean. Take a good look at the springs that control the valve positions in the CVT: They're very small and have very little tension. It wouldn't take much to hang a valve in this valve body, so be careful and be extra clean when rebuilding these units.



Figure 9: Be careful reconnecting the solenoids to the electrical harness; the connectors are identical, and can easily be crossed during reassembly.



WIT
WHATEVER IT TAKES
TRANSMISSION PARTS, INC.

"A Unique Name,
A Unique Company!"
800-940-0197

**"A Unique Name,
A Unique Company!"**

Call us and see why we are the fastest growing complete line transmission parts distributor in the Industry!